



# Data Logging Transducer for Pressure Vessels

Steve Wnuk  
Pressure Systems Manager  
NASA Glenn Research Center

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# p/T Sensing/Data Recorder Pilot

**GOAL:** Provide pilot demonstration of capturing actual vessel p/T data history to enhance accuracy of “useful life” analysis over vessel’s lifetime



## **APPROACH:**

- Select intrinsically safe, rugged pressure and temperature data logger
- Demonstrate its application in two environments
  - SSC: E-1, LN<sub>2</sub> System, 100 psig max
  - GRC/PBS: Facility GN<sub>2</sub> vessel, 2800 psig max
- Monitor pressure and temperature at user-programmable reading intervals
- Assess user-friendliness features of data display and analysis
- Evaluate suitability for widespread application at RPT sites

**EXPECTED PAYOFF:** Vessel p/T duty cycle history will be recorded for use in more accurate stress/fatigue lifecycle calculations instead of estimation, with attendant conservatism and margins in useful life projections

# Glenn Research Center Status



## INSTALLATION

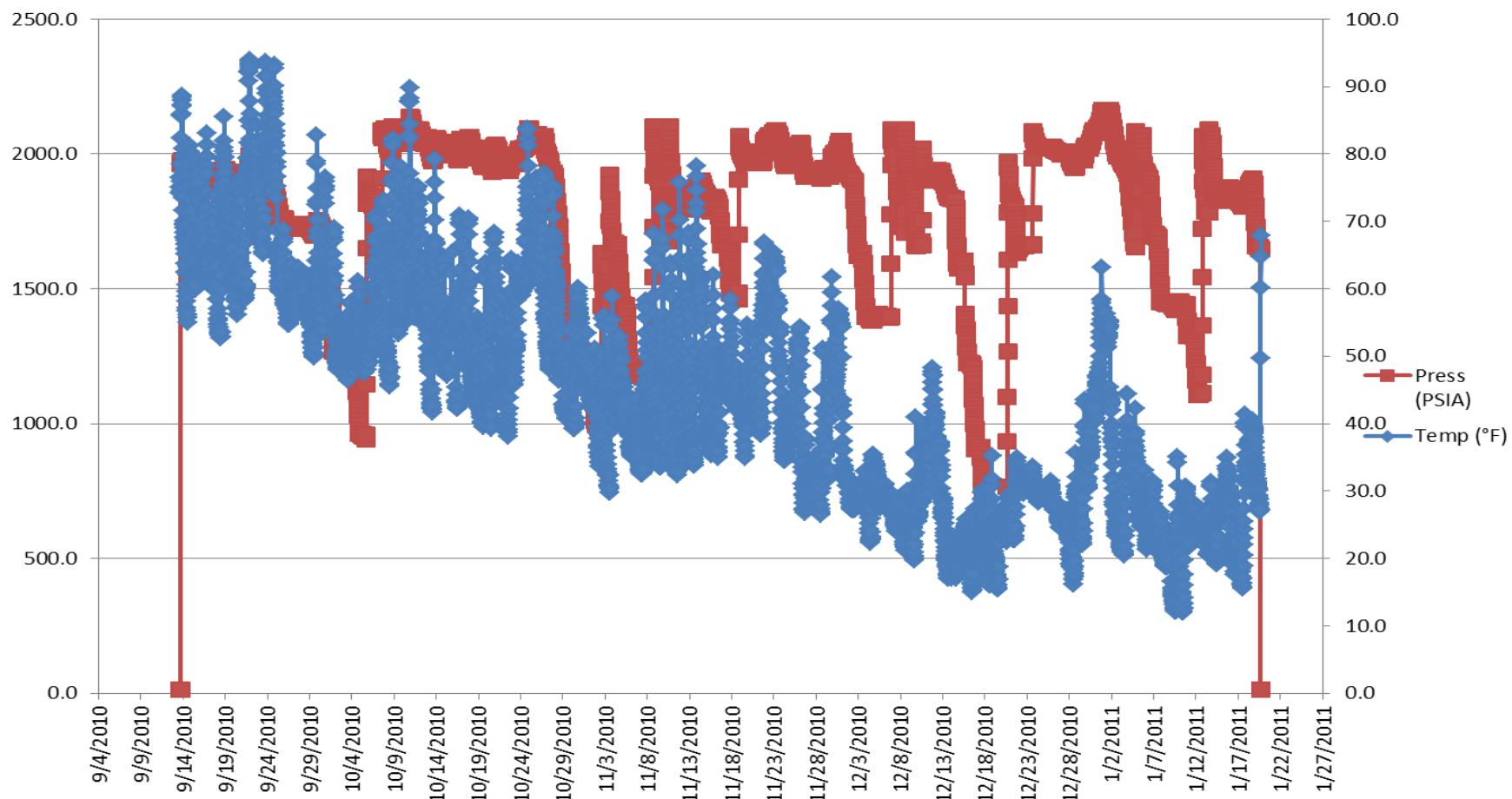
- High range transducer (0 – 5000 psig) was received, initiated, and installed on high pressure gaseous nitrogen vessel N-6-S
- Vessel operating range 1500 – 2200 psig
- Moderate continental climate with summer highs reaching into the lower 90's °F and winter lows dipping into the lower teens; winter extremes of -20°F occur on an average of once a decade
- Transducer was plumbed directly into the vessel pressure sense line in parallel with the primary pressure display gauge and was mounted on same indicator panel as gauge

# **Glenn Research Center Status**

## **RESULTS**

- Device was set to collect data at the default rate of once every 30-minutes (48 points per day)
- Transducer began service directly monitoring vessel gaseous nitrogen pressure in September, 2010; an initial data download was successfully acquired in January, 2011
- Transducer remained in service for two more years until January 2013
- Download of the data acquired at that time indicated that transducer memory had reached full capacity in August 2011, and that no subsequent data points were recorded

# Glenn Research Center Status



4-month data set from Sept 2010 to Jan 2011

# **Glenn Research Center Status**

## **PRO's**

- The initial battery lasted the entire two year period, which is twice the advertised limit
- Over its two year trial period the device easily tolerated climate extremes (rain, snow, and sleet) without any special protection

## **CON's**

- Due to unfamiliarity with the device, technicians did not know to reset the buffer
- There was no visual indication that the device was at full capacity; test trial was terminated at this time and the transducer was retired from the trial as well

# Stennis Space Center Status



SSC Transducer Installation on LN2 Dewar

## INSTALLATION

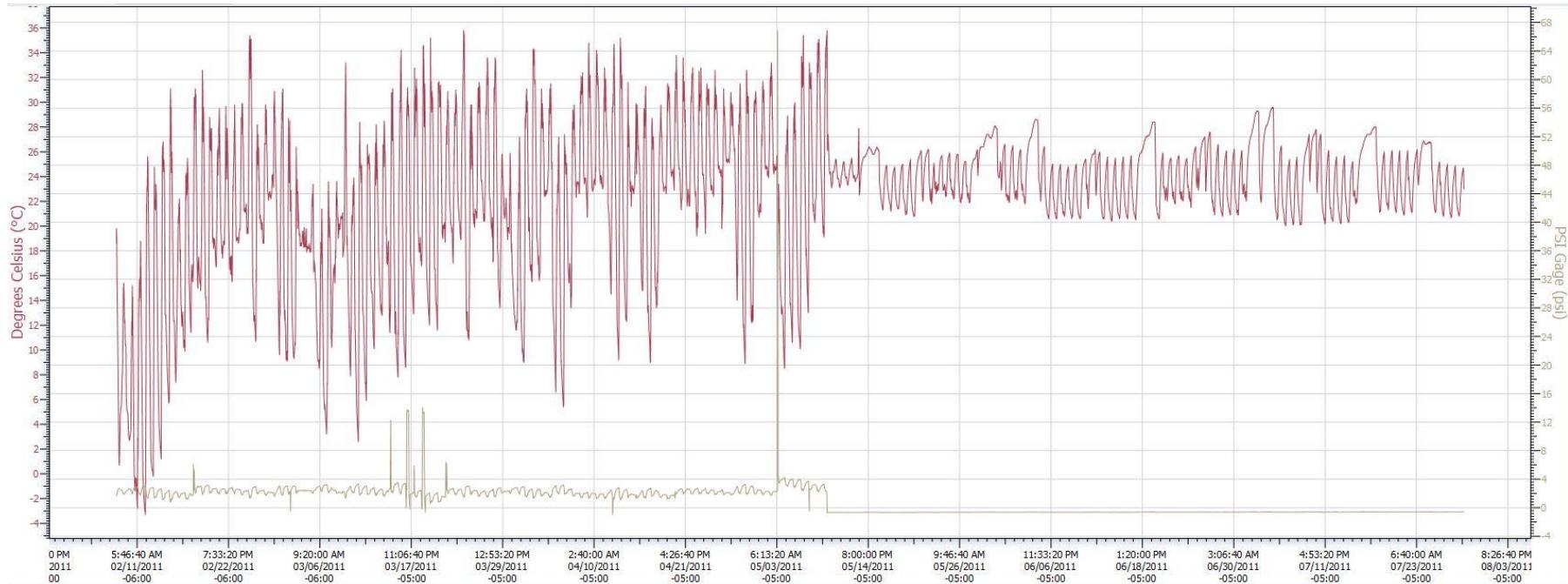
- Low range transducer (0 – 100 psig) was received, initiated, and installed on liquid nitrogen vessel
- Vessel operating pressure range of 0 – 15 psig
- Southern climate with summer highs reaching into the lower 100°F and winter lows dipping into the lower 30°F
- Transducer was plumbed directly into the vessel pressure sense line in parallel with PT-10A42-LN and was mounted on the same indicator panel

# Stennis Space Center Status

## RESULTS

- Device set to collect data every 15-minutes (96 points per day)
- Transducer began monitoring vessel pressure in December, 2010
- Initial data download was successfully acquired in January, 2011
- Initial data integrity was suspect – pressure and temperature cyclic trend was inverse of expected
- Review of vessel prints revealed transducer was measuring vessel low side
- Transducer memory cleared and unit reinitiated in February 2011
- Device remained in service until October 2011, yet had ceased functioning properly by May 2011
- Spikes on pressure graph corresponds with days of vessel activities (LN transfer and offloading)

# Stennis Space Center Status



*Information collected by data logging transducer at SSC site from Feb 2011 to Aug 2011.  
Pressure data is shown in grey and temperature data is shown in red.*

# **Stennis Space Center Status**

## **PRO's**

- The initial battery also lasted as advertised
- Over its trial period the device easily tolerated climate extremes without any special protection

## **CON's**

- There was no visual indication that the device had failed; test trial was terminated in October 2011 and the transducer was retired from the trial as well

# Conclusion

- Transducer performed as advertised
- Purchase price with accessories can exceed \$1000 per unit (CY2010) which makes them uneconomical for widespread application to smaller vessels
- Limited battery life and lack of visual health/status indicators could limit critical applications
- The devices are not readily calibrated and are unsuitable for high precision test data collection

# **Recommendation**

**For future application and study of data logging transducers:**

- Application should involve vessels in the type of service where fatigue is a credible damage mechanism and where extending fatigue life can produce tangible savings
- Applications must involve service commodities that are compatible with the device; cryogenic fluids, gaseous hydrogen, or highly reactive commodities may not be suitable for these transducers
- For any application, a formal monitoring program should be established and personnel trained in use and operation of the transducers (these are not set and forget devices - they must be regularly checked and maintained)

# Recommendation

- Seek devices with some visual health/status indicators integral to the device:
  - Having to plug into the device to determine low memory or low battery status can contribute to loss of data
  - Devices with wireless data transfer capability may be desirable in some applications
- These devices should be considered in circumstances where vessels are subject to potential out of tolerance conditions due to process control instabilities; they could provide an attractive monitoring alternative for capturing rogue excursion events